

CMPT260 Midterm Examination
November 1, 2001
Closed Book, Four sheets of notes allowed.

1. Given the argument: $A \Rightarrow (B \Rightarrow C) \vdash (A \wedge B) \Rightarrow (B \wedge C)$
 ✓a) (3 marks) Provide a formal proof of this argument drawing only from the Deduction Theorem (DT), Modus Ponens (MP), Law of Simplification (LS), and the Law of Combination (LC). *HINT: Use $A \wedge B$ as an assumption.*

$A, A \Rightarrow B \models B$	Modus Ponens
$A \wedge B \models A$	Law of Simplification
$A, B \models A \wedge B$	Law of Combination

- b) (3 marks) Restate the argument, removing all implications. Simplify and show that the premises are truth functionally equivalent to the conclusion.

2. Given the predicate $(\forall x(P(x) \Rightarrow Q(x))) \Leftrightarrow (\exists x(P(x)) \Rightarrow \forall x(Q(x)))$

- a) (4 marks) Give an assignment that makes the predicate True
 b) (4 marks) Give an assignment that makes the predicate False

3. Translate the following sentences into ^{propositional} propositional calculus.

- a) (2 marks) All lions are mammals, but not all mammals are lions.
 b) (3 marks) Except for John, everyone had a good time at Halloween.

- ✓4. (3 marks) Let the operator \circ be defined as follows. Find $(x \circ (y \circ z)) \circ x$ where $x = a$, $y = c$, and $z = b$.

	a	b	c
a	a	b	b
b	a	c	b
c	c	a	b

5. (6 marks) Write a Prolog procedure `find(N, List, Value)` that succeeds if Value is the N^{th} element of List.

6. (4 marks) Write a Prolog procedure `same(List1, List2)` that succeeds if the two lists have at least one element in common. *Hint: You only need to use the member procedure studied in class.*

- ✓7. (3 marks) Give the composition $R \circ S: A \leftrightarrow B$ of A, B, and C where $R: A \leftrightarrow C$ and $S: C \leftrightarrow B$ and

$A = \{a, b, c\}$, $B = \{3, 2, 1\}$, $C = \{x, z, y\}$
 $R = \{(a, z), (b, y), (c, x)\}$
 $S = \{(z, 3), (y, 2), (x, 1)\}$